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October 11, 1990

Dr. Michael Marron, Code N00014
Scientific Program Officer
Office of Naval Research
Biological Science Division
Code 1141MB
800 North Quincy Street
Arlington, VA 22217-5000

dist

Re: Contract Number N00014-87-K-0431
Principal Investigator Professor Robert Alfano
"Cancer Diagnosis by Laser Spectroscopy"

Dear Dr. Marron,

Enclosed herewith please find a copy of the Annual Letter Report for the above referenced contract.

Sincerely,

Stanley Watkins (no)

Stanley Watkins, Director
Office of Research Administration

nc
encl.

cc: Prof. R. Alfano, w/encl.
ONRRR, N.Y., N.Y. w/encl.
Director, NRL, Code 2627 w/encl.
DTIS, Bldg 5, VA w/encls.
RF 447240

ANNUAL LETTER REPORT—DATE 10/1/90

Cancer Diagnosis by Laser Spectroscopy

N0014-87-k-0431

Sept-1st-1987 to Oct.1st-1990

R. R. Alfano
Institute for Ultrafast Spectroscopy and Lasers
The City College of New York
New York NY 10031

The objective of this project is to investigate and develop novel optically based diagnostics modalities to distinguish between normal and cancerous tissues using various types of steady state and ultrafast laser spectroscopy. Significant work has been completed over the past year.

Raman and fluorescence spectroscopy have been studied for human leukemia and normal white blood cells in the visible spectral region as well as for human benign breast tissues, benign breast tumor and malignant breast tumors in the near infrared region. The Raman lines were observed from normal white blood cells but not from leukemia white blood cells. Using IR Raman scattering different intensities and numbers of Raman active modes were measured for benign and malignant tumor tissues. Our preliminary results suggest a new novel approach to diagnose leukemia and benign and malignant tumor using spectral positions and intensities of Raman lines.

Picosecond fluorescence kinetics from benign and cancer tissues as well as from atherosclerotic plaque have been measured. The time-resolved fluorescence profiles were fitted to a double exponential with a fast and a slow component. The kinetics appears to be different between benign and malignant tumors. For atherosclerotic plaque the kinetics appears to have different lifetimes from normal artery.

UV Fluorescence Spectroscopy been studied for over forty samples of cancerous and non-cancerous breast tissues. The ratio of fluorescence intensity between two defined wavelengths was found to be different between malignant tumor, benign tumor , benign tissue, and normal tissue. The average ratio for nineteen malignant samples is 15.7, for twenty benign tissues and tumors is 4.7. The ratio range for cancer extends from 10 to 20 while that for benign samples is 2 to 9. Blind samples were tested and the results are in 98% agreement with the diagnosis made by the pathologists.

Fluorescence lifetime and quantum yield of photo-active Doxycycline dye which has a potential used for photo-dynamic therapy have being studied in the excitation intensity range from 10^7 W/cm^2 to 10^9W/cm^2. The fluorescence lifetime with about a 100 ps fast component and a 400 ps slow component did not change over this intensity range. The relative fluorescence quantum yields in the excitation intensity range from $5X10^{14}$ photons/cm^2 to $6X10^{16}$ photons/cm^2 changed--- the curve was linear up to the incident intensity upto $5X10^{15}$ photons/cm^2. After this intensity the quantum yield decreases monotonically. These results appear to arise from the excited state absorption at high excitation intensities.

Light scattering has been studied on model latex sphere systems in the time and angle domains as a possible diagnostic method.